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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/648,750	08/28/2000	Chihiro Uchibori	P108077-00000	6477

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EXAMINER

LEE, GRANVILL D

ART UNIT	PAPER NUMBER
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2825

DATE MAILED: 12/21/2001

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/648,750

Applicant(s)

UCHIBORI, CHIHIRO

Examiner

Granvill D Lee, Jr

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 December 2000.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Specification

The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claims 1, 6, 13-15, 17, 20 and 22, are rejected under 35 U.S.C. 102(e) as being anticipated by Dubin (US. Pat. 6,249,055).

In view of claims 1, 6 and 14-15 Dubin makes a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (Ta_N), an interconnect layer using copper (Col. 6 lines 50-55), and an aluminum seed layer which can act as an adhesion layer to contain zirconium (Col. 5 lines 60-66).

In view of claim 13, Dubin depicts a via or hole structure (Fig. 1# 13b).

In view of claim 17, Dubin makes a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (TaN), an interconnect layer using copper (Col. 6 lines 50-55), and an aluminum seed layer which can act as a adhesion layer to contain zirconium. Then removes the top portion of the interconnect material (Fig. 2 & 3).

In view of claim 20, Dubin makes a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (TaN), an interconnect layer using copper (Col. 6 lines 50-55), and an aluminum seed layer which can act as a adhesion layer to contain zirconium. Then, conducts a low temperature anneal to diffuse the atoms (Abstr.).

In view of claim 22, again Dubin makes a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (TaN), an interconnect layer using copper (Col. 6 lines 50-55), and an aluminum seed layer which can act as a adhesion layer to contain zirconium, then a chemical mechanical polishing (CMP) is done to the surface (Col. 6 lines 4-8).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary

Art Unit: 2825

skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2, 7 and 19, are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin (US. Pat.6,249,055) in view of Kim et al. (US. Pat. 4,751,349).

In view of these claims, Dubin discloses a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (TaN), an interconnect layer using copper (Col. 6 lines 50-55), and an aluminum adhesion layer. (In regard to esp. claim 2, where Dubin suggests that an adhesion layer can be deposited prior to a seed layer) Kim et al. teaches that zirconium is the main element in a multi-layer metallic structure. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the teachings of Dubin with those of Kim et al. with the expectation of achieving better adhesion results, since it was discovered by Kim et al. that superior strength is available when used in conjunction with copper (Col. 1 line 64-col. 2 line 5).

In view of claim 7, Dubin suggests that an adhesion layer can be deposited prior to a seed layer (Col. 7 line 33-39).

In view of claim 19, Kim et al. depicts a second layer of zirconium over the copper layer (Fig. 2 #48), which is not unusual in multi-level structures.

Claims 3-4, 8-12, 16, 18, 21 and 23-25, are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin (US. Pat.6,249,055) in view of

Art Unit: 2825

Kim et al. (US. Pat. 4,751,349) and in further view of Venkatraman (US. Pat. 5,677,244).

Dubin discloses a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (TaN), an interconnect layer using copper, and an aluminum adhesion layer. Kim et al. teaches that zirconium is the main element in a multi-layer metallic structure. Yet, neither inventor discloses an interconnection structure where islands are present. Venkatraman may help both inventors by disclosing a copper interconnection structure where islands are grown (Fig. 3). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the teachings of both inventors with the teachings of Venkatraman with the expectation of achieving better adhesion results, since the film used to grow the islands of conductive material improve the adhesion of the filling material (Col. 1 line 65-Col. 2 line 5).

In view of claims 3, 8-9, 12, 16 and 25, Venkatraman shows a spacing of the island of 10 or more angstroms and are on the barrier layer (Col. 1 line 66-Col. 2 line 5).

In view of claims 4 and 18, Venkatraman tells how the islands are underneath the barrier layer (Col. 1 line 66-Col. 2 line 5) and between the barrier layer and the conductive layer (Fig. 2 & 3).

In view of claims 10-11 and 23-24 Venkatraman depicts an island with a thickness of 5-75 angstroms, similar to its diameter (Fig. 3).

In view of claim 21, Venkatraman depicts a low temperature annealing process to diffuse the atoms of the adhesion layer into the copper and other layers (Col. 5 lines 50-55).

Claims 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin in view of Farrar (US. Pat. 6,284,656).

Dubin discloses, as indicated, a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (TaN), an interconnect layer using copper, and an aluminum adhesion layer. However, Dubin does nothing to suggest the solubility or the resistivity of the material used. Farrar assists in some sense to suggest that zirconium is used to lower the solubility (Col. 4 lines 27-33) but not increase resistance to much (Col. 4 lines 43-47).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the teachings of Dubin with those of Farrar with the expectation of achieving better characteristics, because it appears that zirconium is stronger in several ways over titanium (Col. 4 lines 27-60).

Contact Information

Any inquiry concerning this communication or earlier communications for the examiner should be directed to Granvill Lee whose telephone number is (703) 306-5865. The examiner can be normally reached on Monday thru Thursday from 7:00 am to 5:30 pm.

If attempts to reach the examiner by telephone are not successful,

Art Unit: 2825

the examiner's supervisor, Matthew Smith can be reached on (703) 308-1323. The fax phone number for this group is (703) 308-7722.

Any inquiry of a general nature relating to status or otherwise should be directed to the receptionist whose telephone number is 703-308-1782.

Examiner
Granvill Lee
Art Unit 2825

Gl
12/14/01



MATTHEW SMITH
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